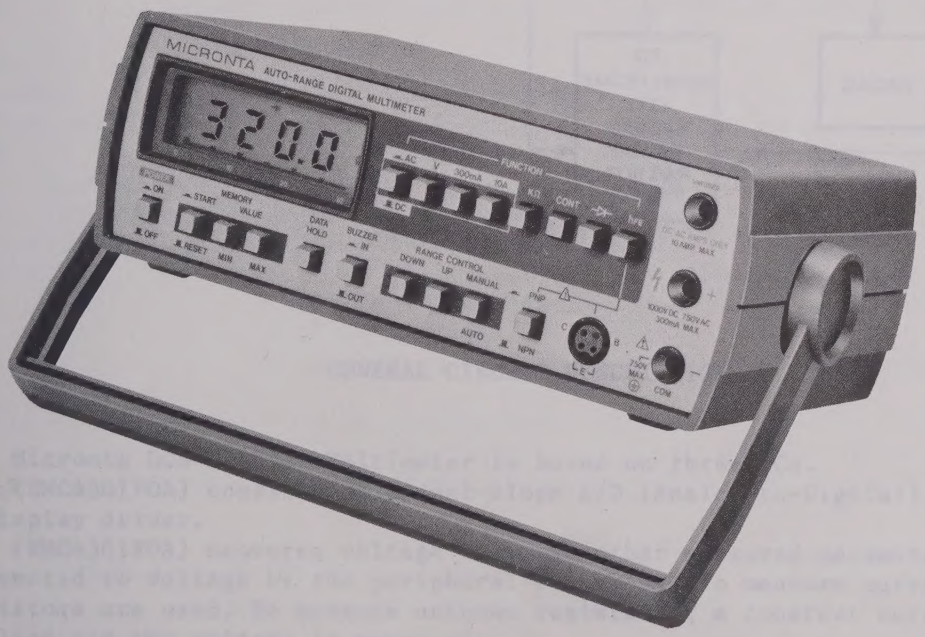
MICRONTA®

Service Manual

22-195

LCD BENCHTOP DIGITAL MULTIMETER

Catalog Number: 22-195



CUSTOM MANUFACTURED FOR RADIO SHACK, A DIVISION OF TANDY CORPORATION

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NOTE: For disassembly, see Exploded View/Disassembly on page 34.

SPECIFICATIONS

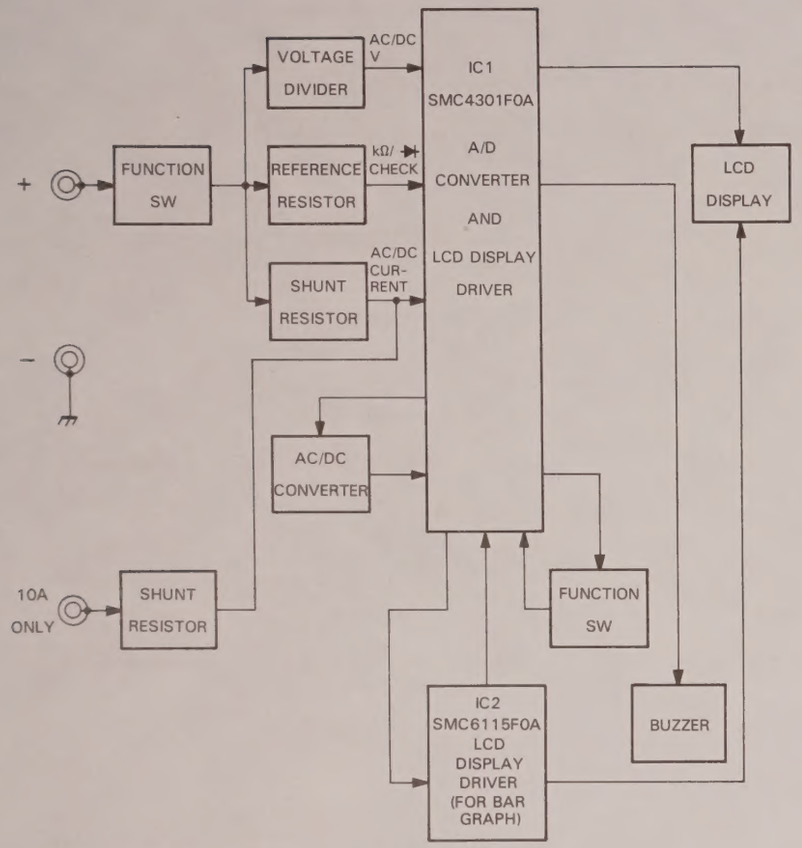
Display : 3 2/3 digit LCD

Accuracy	Nominal	Limit
DC Volts		
300mV-3-30-300-3000 V (Maximum measurement =1000 Volts)	±0.8% of reading and ±0.2% of full scale, ± 1 in last digit	±1.0% of reading and ±0.2% of full scale, ± 1 in last digit
AC Volts		
3-30-300-3000 V (Maximum measurement =750 Volts RMS) at 50/60 Hz	± 1 % of reading and ±0.5% of full scale, ± 1 in last digit	±1.5% of reading and ±0.5% of full scale, ± 1 in last digit
45 Hz to 500 Hz at 30 Volt Range	±1.5% of reading and ±0.5% of full scale, ± 1 in last digit	
500 Hz to 10 kHz at 30 Volt Range	±10 % of reading and ±0.5% of full scale, ± 1 in last digit	
DC Currents		
300mA-30 A (Maximum measurement =10 A)	±1.5% of reading and ±0.2% of full scale, ± 1 in lst digit	±2.5% of reading and ±0.2% of full scale, ± 1 in last digit
AC Currents		
300mA-30 A (Maximum measurement =10 A)	±1.5% of reading and ±0.5% of full scale, ± 1 in last digit	±2.5% of reading and ±0.5% of full scale, ± 1 in last digit
Resistance		
300ohm-3-30-300 -3000 kohm	±1.5% of reading and ±0.2% of full scale, ± 1 in last digit +5 digit maximum at 300 ohm	±2.0% of reading and ±0.2% of full scale, ± 1 in last digit
30 Mohm	± 3 % of reading and ±0.2% of full scale, ± 1 in last digit	± 5 % of reading and ±0.2% of full scale, ± 1 in last digit

Continuity Function	Continuity buzzer sounds with less than 295 ohms (±20 ohms) input resistance. Buzzer sounds 100ms-150ms after input is shorted.
Diode Check Function	Checks if diodes are open, shorted or normal.
Transistor Check Function	Measures h_{FE} of small signal transistor 1B=10μA Vce : 2V Typical
Memory	Keeps in memory the values on the bar graph and recalls the Max./Min. values after MEMORY START Switch is pressed in.
Bar Graph	31-dot display (including zero) A/D 6 bit. Accuracy : ±4 LSB
Input Impedance	10 Mohm (DC V/AC V). More than 100 Mohm on 300mV DC.
Range Selection	Full auto range or manual range control, selectable by RANGE CONTROL (AUTO/MANUAL) switch.
Power Source	Four "C" size 1.5V Batteries
Power Consumption	10mW typical
Low Battery Indication	"BATT" on the left of display below 2.4 V - 2.6 V
Polarity	Automatic polarity
Over Range Indication	3000 with blinking "3". When the measured value exceeds the maximum value, all digits on display will blink in DCV/ACV, DC 10A/AC 10A measurements.
Operating Temperature	32°F to 122°F (0°C to 50°C)
Storage Temperature	-4°F to 140°F (-20°C to 60°C)
Weight	1.4 lbs (660 g) Approx.
Size	8" x 4-3/4" x 2-11/16" (200 x 120 x 67 mm)
Accessories	Fuse 0.5 A / 250 V Banana type test leads (Cat. No. 278-704) Terminal cord for h_{FE} measurements

NOTE: Nominal specs represent the design specs; all units should be able to approximate these — some will exceed and some may drop slightly below these specs.
Limit specs represent the absolute worst condition considered acceptable; a unit should never perform to less than any limit spec.

BLOCK DIAGRAM



GENERAL CIRCUIT DESCRIPTION

The Micronta LCD Digital Multimeter is based on three ICs.
IC1 (SMC4301F0A) consists of a dual-slope A/D (Analog-to-Digital) converter and a display driver.
IC1 (SMC4301F0A) measures voltage only, so other measured parameters must be converted to voltage by the peripheral circuitry. To measure current, shunt resistors are used. To measure unknown resistance, a constant current is applied and the voltage is measured.
IC2 (SMC6115F0A) is a display driver for bar graph and the memory function.
IC3 (LA5002) is a voltage regulator for h_{FE} measurements.

IC DESCRIPTION

The 4301F0A chip (IC1) is a high-performance, low power CMOS 3-2/3 digit analog/digital converter. All necessary active devices are present, including seven-segment decoder/driver, reference voltage and internal clock. Clock frequency is 32 kHz and the reference voltage is 164 (mV).

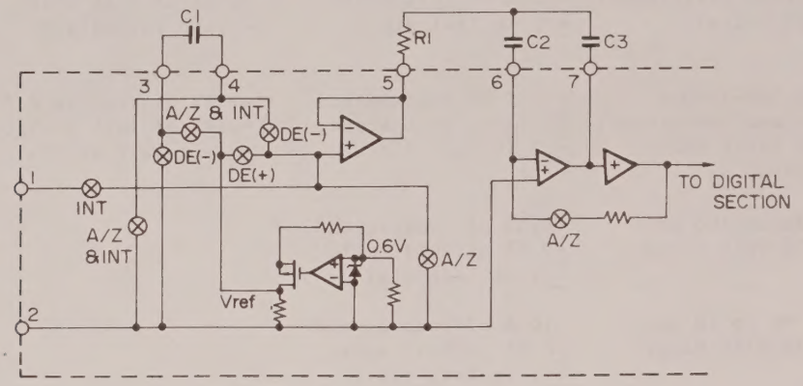


Figure 1. Analog Section of IC1

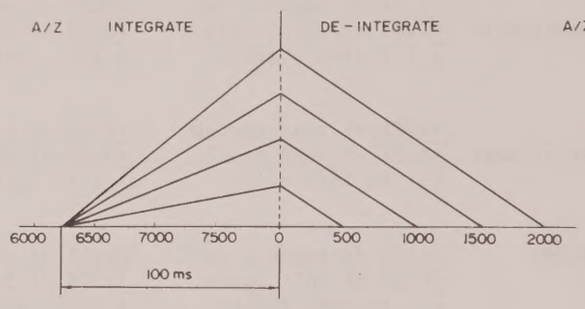


Figure 2. IC1 Operating Timing

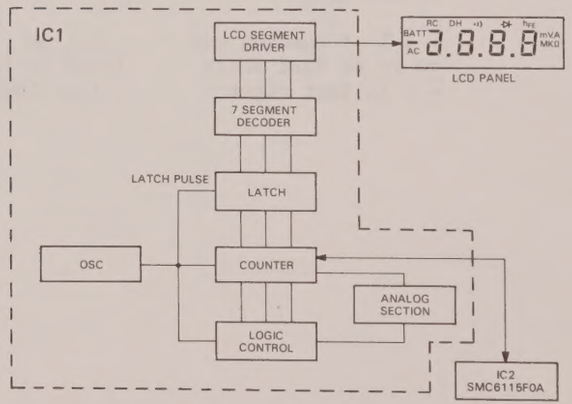


Figure 3. IC1 (SMC 4301 FOA) Block Diagram

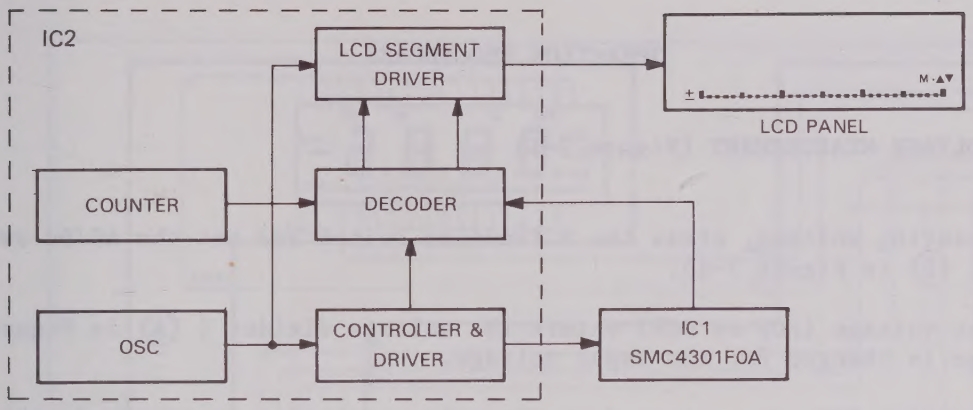


Figure 4. SMC 6115 FOA (IC2) Block Diagram

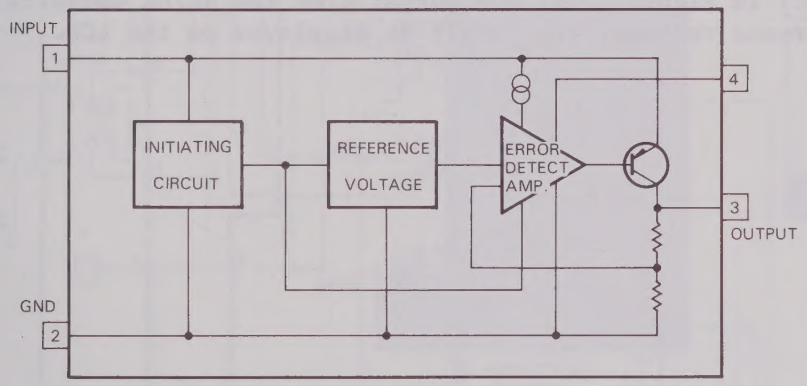


Figure 5. LA5002 (IC3) Block Diagram

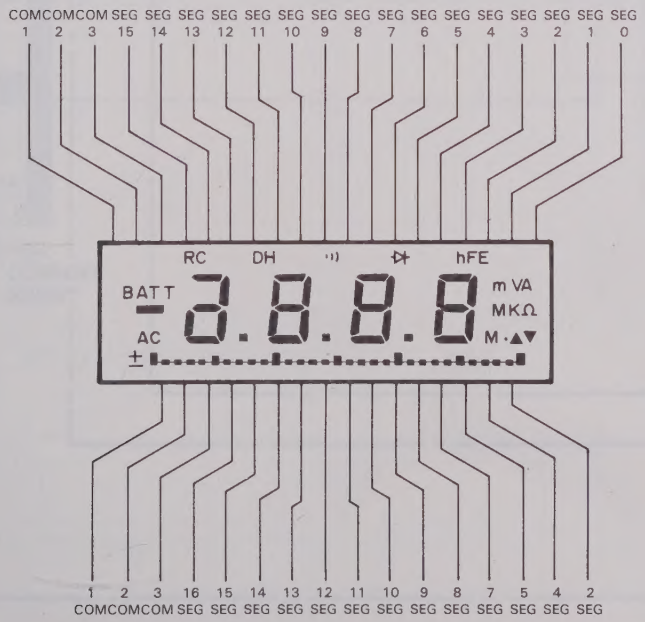

COMCOMCOM SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG
1 2 3 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
RC
DH
hFE
BATT
AC
m VA
MKΩ
M·▲▼
1 2 3 16 15 14 13 12 11 10 9 8 7 5 4 2
COMCOMCOM SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG SEG

Figure 6. LCD PIN Configuration

OPERATION PROCEDURES

AC/DC VOLTAGE MEASUREMENT (Figure 7-1)

When measuring voltage, press the V function switch and set the AC/DC selection switch (Ⓑ in Figure 7-1).

The input voltage (ACV or DCV) enters the voltage divider (Ⓐ in Figure 7-1). The range is changed for the input voltage.

When measuring DCV, the output from the voltage divider is compared with the reference voltage. The result is displayed on the LCD.

When measuring ACV, the output from the voltage divider is changed in the AC/DC converter (Ⓒ in Figure 7-1). The output from the AC/DC converter is compared with the reference voltage. The result is displayed on the LCD.

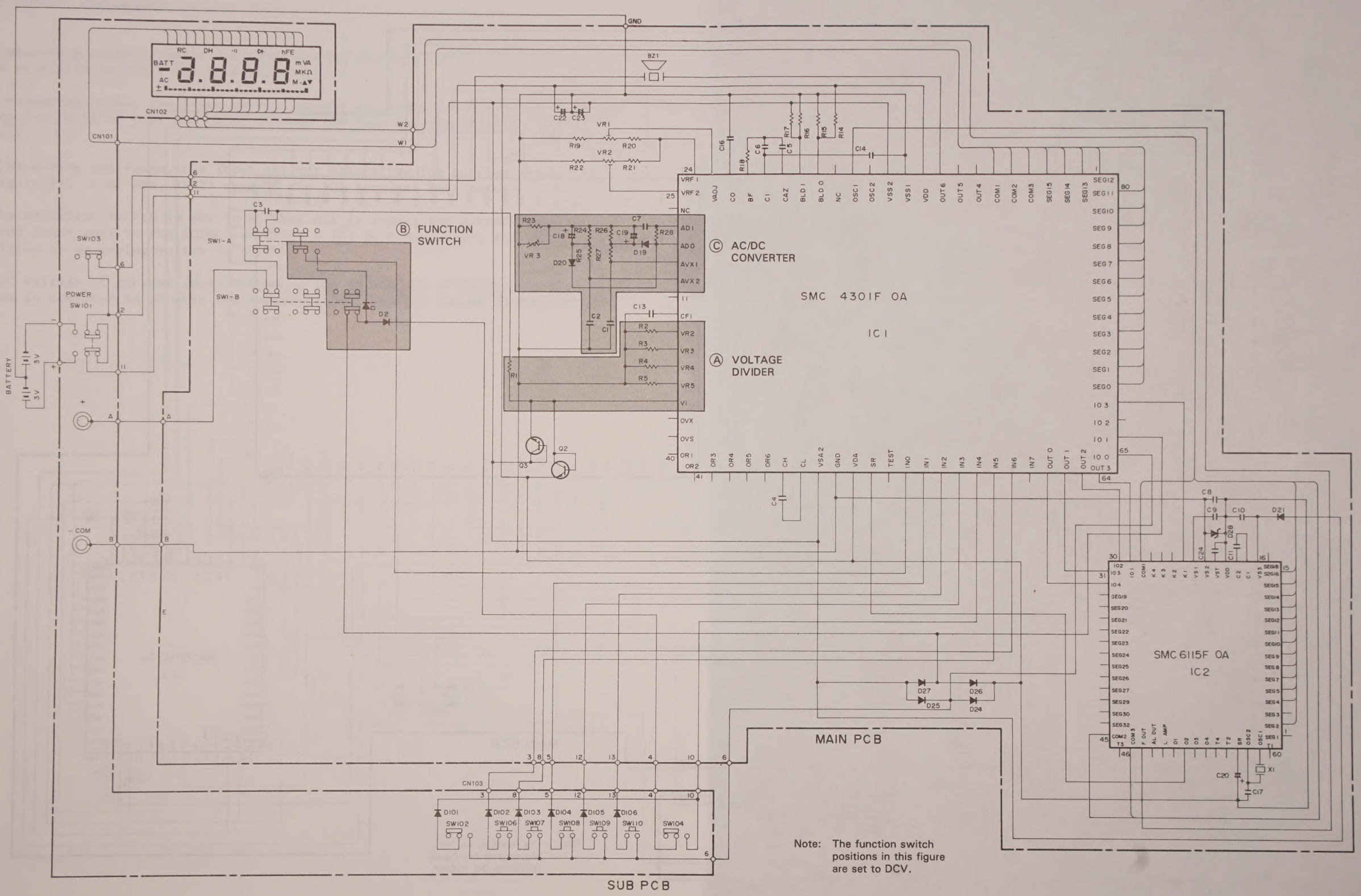
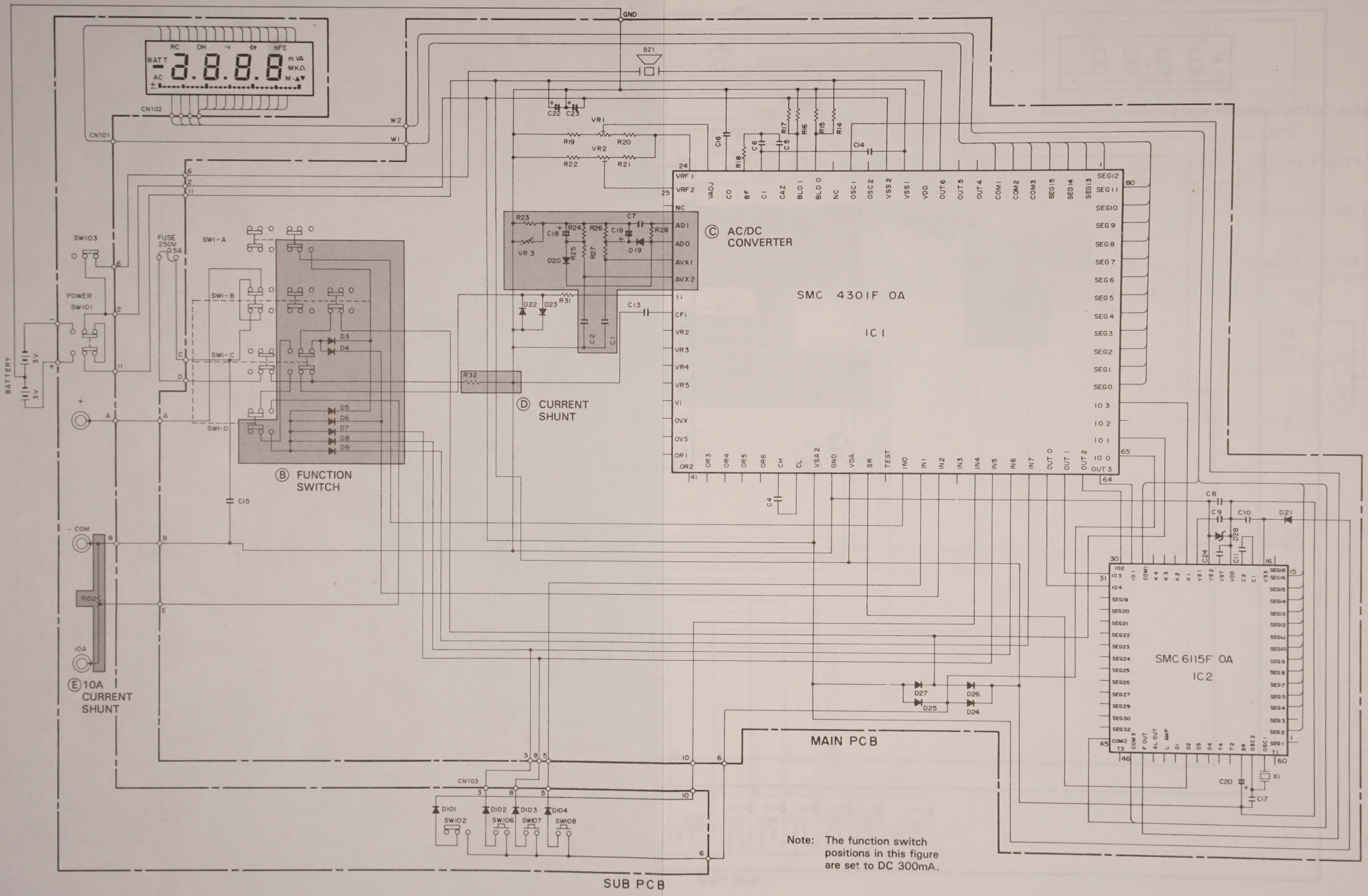


Figure 7-1. Diagram of AC/DC Voltage Check



Note: The function switch positions in this figure are set to DC 300mA.

Figure 7-2. Diagram of AC/DC Current Check

AC/DC CURRENT MEASUREMENT (Figure 7-2)

When measuring current, press the 300mA or 10A function switch and set the AC/DC selection switch ((B) in Figure 7-2).

When measuring 300mA, the input current enters the 300mA current shunt ((D) in Figure 7-2. 0.91 or 0.92 ohm, R32) through the fuse and the 300mA function switch.

When measuring 10A range, the input current enters the 10A current shunt ((E) in Figure 7-2. 0.01 ohm, R102) through the 10A terminal (not fuse-protected).

If the selection switch is set to AC when ACA is input, the output from the current shunt goes to the AC/DC converter ((C) in Figure 7-2), and is rectified by an analog switch in IC1.

The DC voltage of current shunt output or the AC voltage of AC/DC converter output is compared in IC with the reference voltage. The result is displayed on LCD.

RESISTANCE MEASUREMENT (Figure 7-3)

A ratio determines resistance. Press the Kohm function switch ((B) in Figure 7-3). A series circuit is formed by the internal reference voltage, the selected reference resistors ((F) in Figure 7-3) and the resistance to be measured.
The ratio of the two resistors is equal to the ratio of their respective voltage drops. Since the value of the reference resistors is known, A/D converter calculates the value of the unknown resistor as follows:

In the case of integration:

$$V_o(INT) = \frac{Rx\ (Unknown\ Resistance)}{Rref\ (Reference\ Resistor) + Rx\ (Unknown\ Resistance)} \times Vref$$

In the case of de-integration:

$$V_o(DE) = (1 - \frac{Rx}{Rref + Rx}) \times Vref = \frac{Rref}{Rref + Rx} \times Vref$$

$$\frac{V_o(INT)}{V_o(DE)} = \frac{Rx}{Rref}$$

P01 and Q1 constitute the protection circuit from over-voltage (500V AC 1 minute max.).

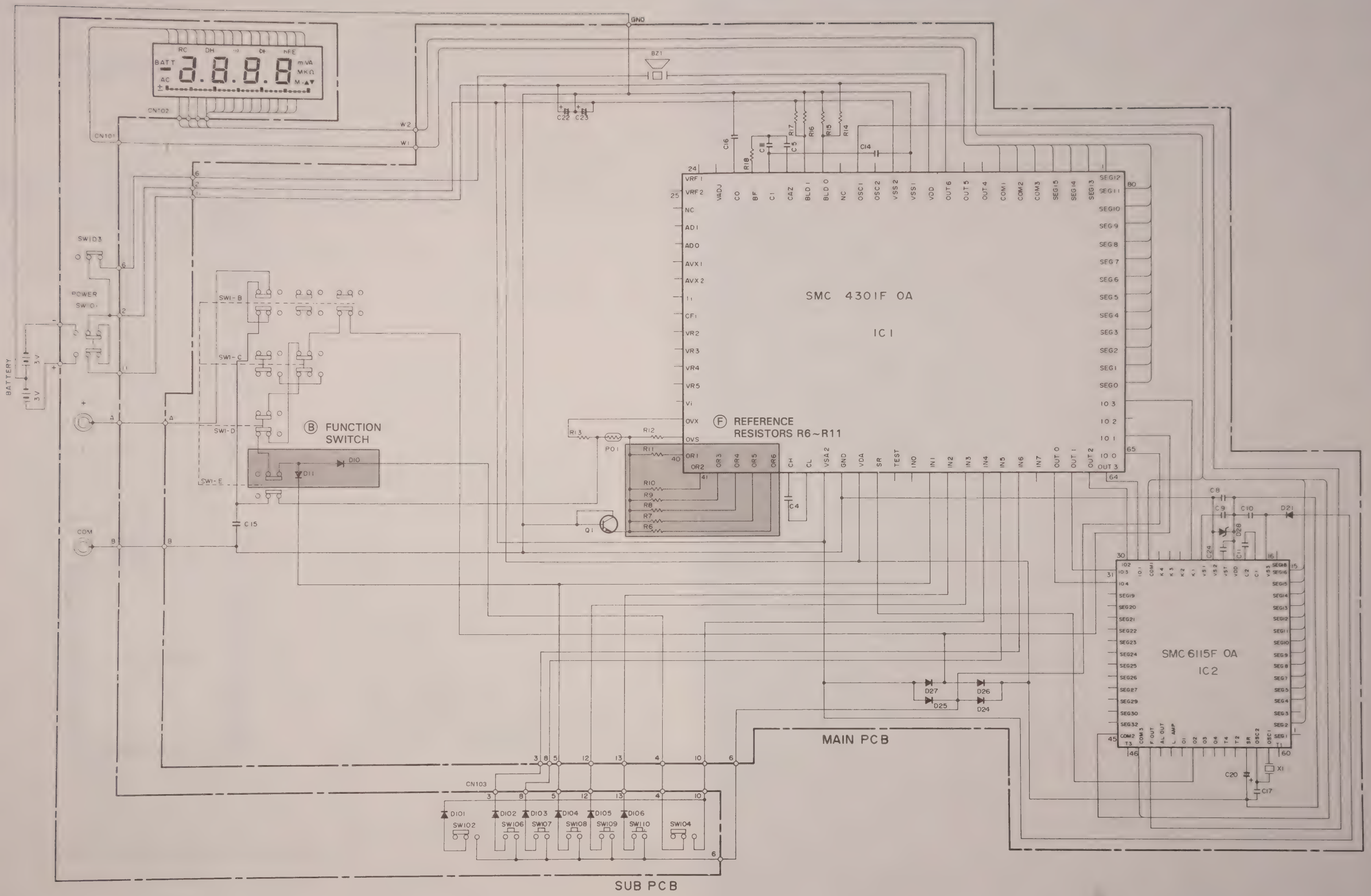
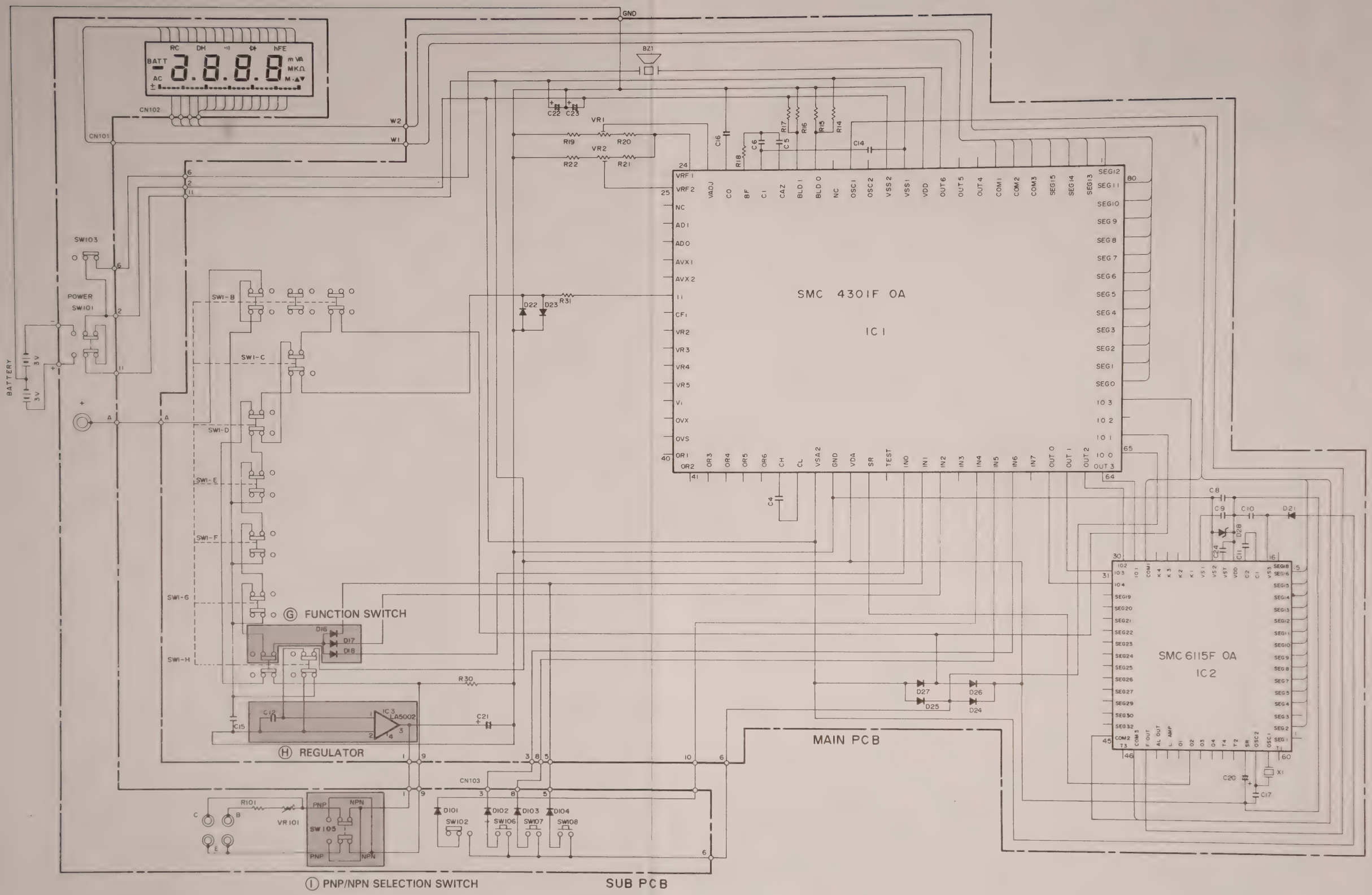


Figure 7-3. Diagram of Resistance Check



Firure 7-4. Diagram of h_{FE} Check

h_{FE} MEASUREMENT (Figure 7-4)

The h_{FE} is the current gain of a transistor, indicated by the ratio of the collector current (I_C) to the base current (I_B).

$$h_{FE} = \frac{I_C}{I_B}$$

Press the h_{FE} function switch (Ⓖ in Figure 7-4). IC3 is the 2V regulator (Ⓗ in Figure 7-4). R101 (51 kohms) and VR101 (100 kohms) adjust the base currents maintaining it at 10μA. Then the collector current flowing through R30 (10 ohms) is recognized as h_{FE}.

SW105 (Ⓘ in Figure 7-4) selects NPN or PNP according to the type of the transistor.

CONTINUITY CHECK

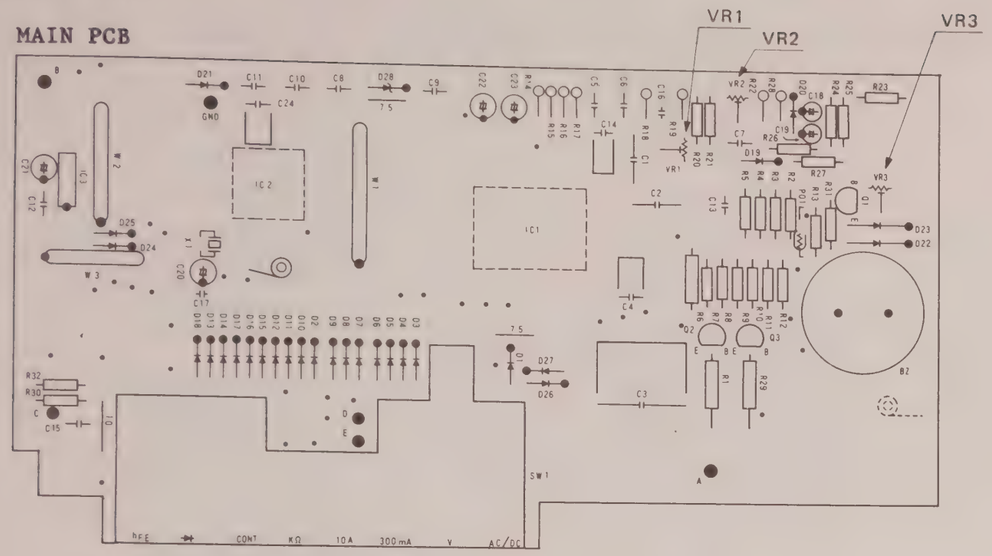
Press the CONT function switch. The range is held at 320 ohm range and the oscillation circuit in IC1 operates. The buzzer sounds if the value is less than 295 ohms nominal.

DIODE CHECK

Since open-circuit voltage between jacks is maintained at 3 volts in the diode check function, you can check continuity of most diodes, LEDs and transistors, etc.
The display value during the diode check function is the forward voltage (2V max).

ALIGNMENT POINTS

MAIN PCB



SUB PCB

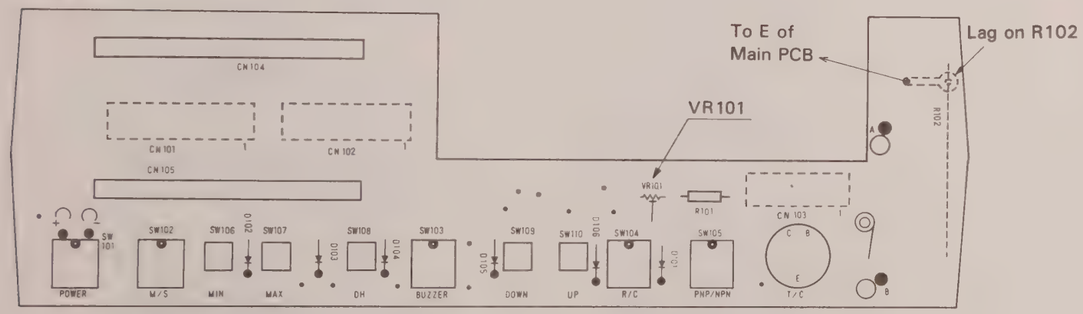


Figure 8. Calibration Points

EQUIPMENT REQUIRED:

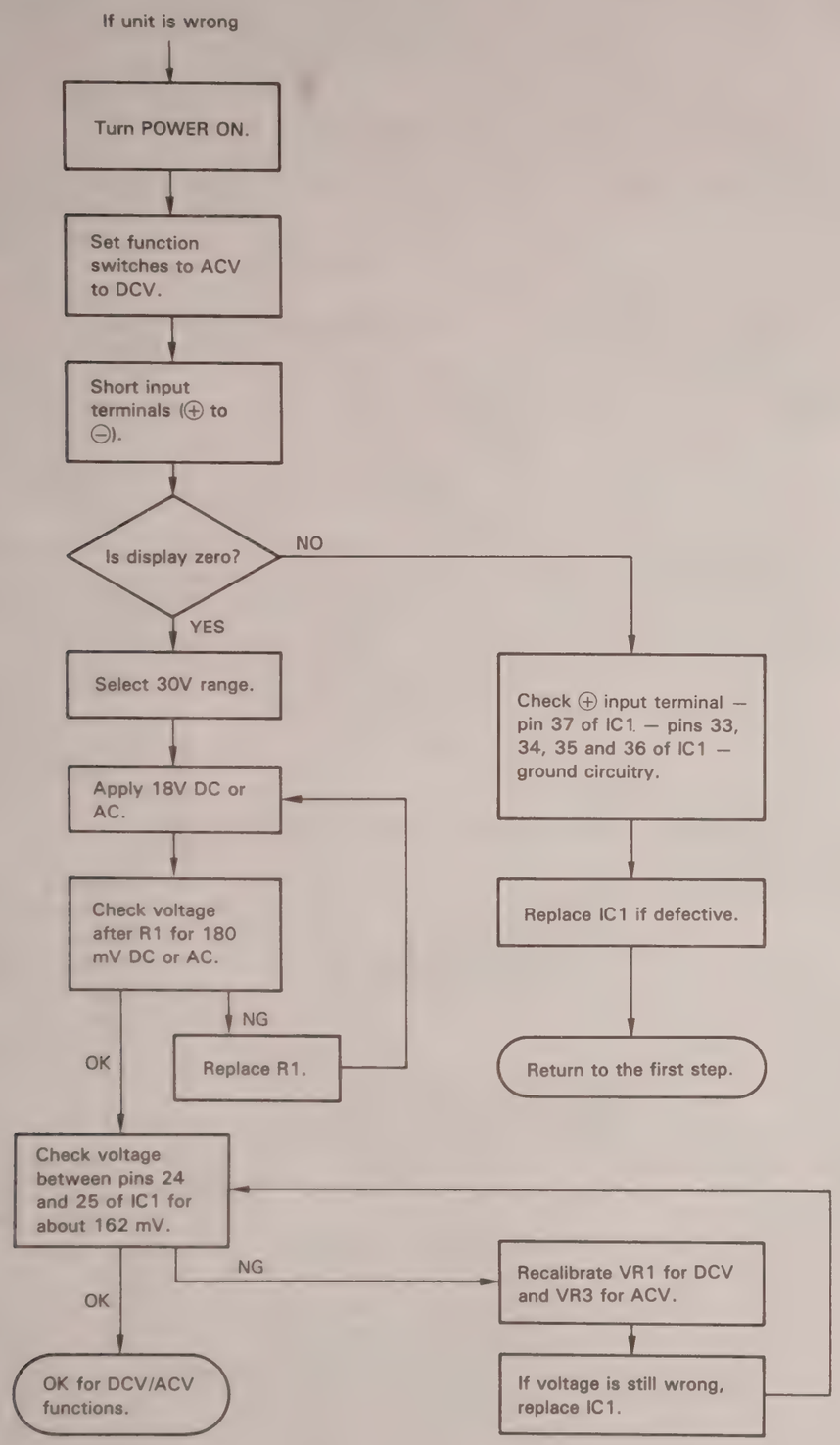
1. AC Calibrator 0 - 750V (±0.1% accuracy, 100Hz - 1kHz)
2. DC Calibrator 0 - 1000V (±0.05%)
3. DC Current Calibrator 0 - 200mA (±0.2%)
4. Resistors 1kohm, 10kohm (±0.1%), 70kohm (±0.1%)
5. Millivoltmeter

PROCEDURES:

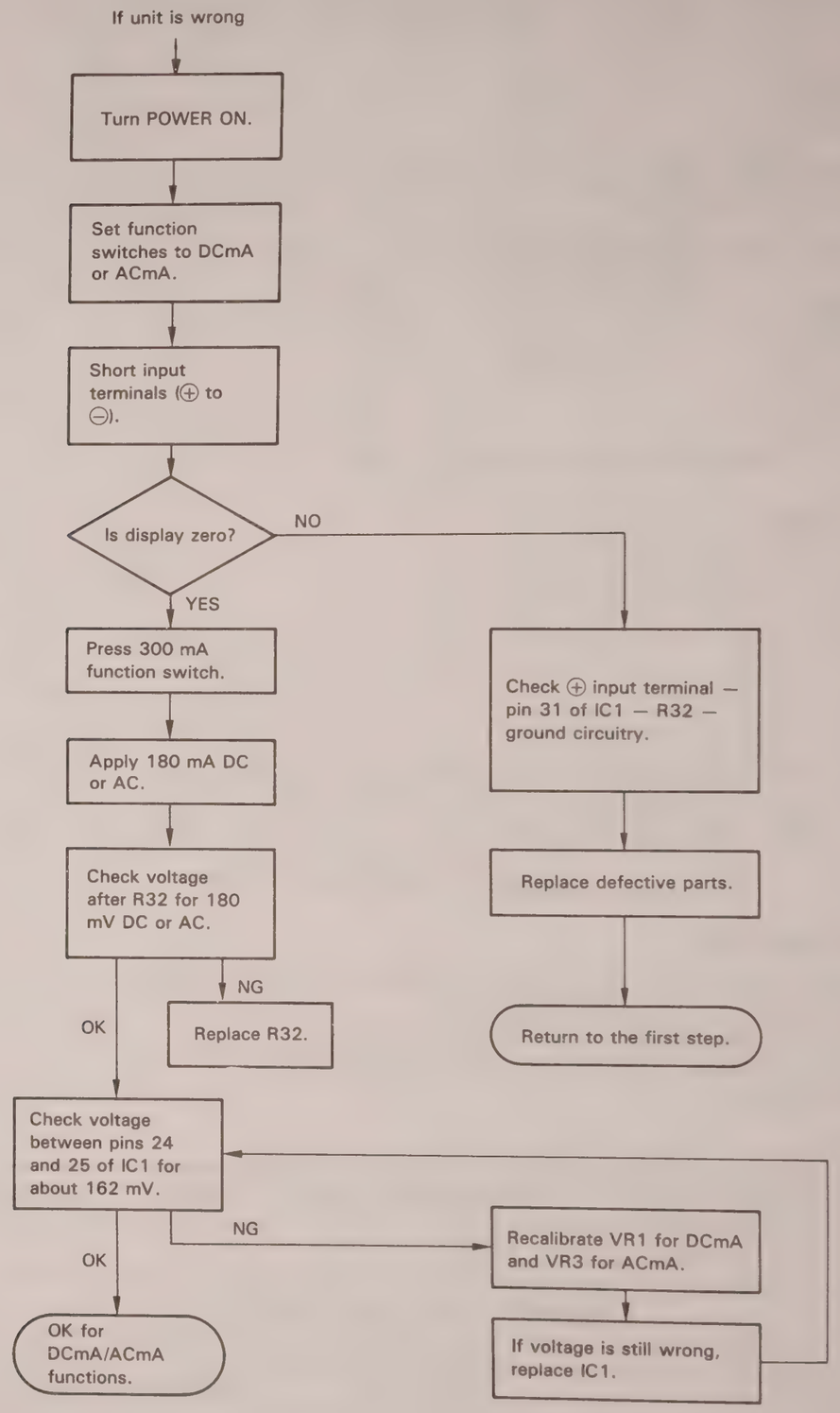
STEP	CONTROL SETTING	CONNECTION & INPUT	ADJUST	ADJUST FOR
1	Set the POWER switch to ON.			
2	**Alignment of Bar Graph Function**			
	Function Switches: DC V	1)Connect DC Voltage Calibrator. 2)Apply 2.800V DC to input.	VR1 (10kohm)	Adjust VR1 so the display reads 2.800.

STEP	CONTROL SETTING	CONNECTION & INPUT	ADJUST	ADJUST FOR
3	**Alignment of DC Voltage Measurement Function**			
	Function Switches: DC V	1)Connect DC Voltage Calibrator. 2)Apply 2.800V DC to input.	VR2 (2kohm)	Adjust VR2 so the display reads 2.800.
4	**Alignment of AC Voltage Measurement Function**			
	Function Switches: AC V	1)Connect AC Voltage Calibrator. 2)Apply 28.00V AC to input (50 or 60 Hz).	VR3 (500kohm)	Adjust VR3 so the display reads 28.00.
5	**Alignment of DC Current 300mA Measurement Function**			
	Function Switches: DC 300mA	1)Connect DC Current Calibrator to input (+) jack and input (-) jack. 2)Apply 280.0 DCmA to input.	/	Check the display if it reads figures within spec. If not, replace R32.
6	**Alignment of DC Current 10A Measurement Function**			
	Function Switches: DC 10A	1)Connect DC Current Calibrator to the input 10A jack and input (-) jack. 2)Apply 10.00A DC to input.	Lag on R102	Adjust the position of the lag on the resist wire R102 so the display reads 10.00.
	Alignment of Resistance Measurement Function			
7	Function Switch: Kohm	Connect the calibration resistance (1 kohm and/or 10 kohm) to the input.	/	Check the display if it reads figures within spec. If not, see "Trouble-shooting."
8	**Alignment of h_{FE} Function**			
	Function Switches: h_{FE} PNP/NPN to NPN	1)Connect the test clip harness to the hFE terminal. 2)Connect a 70 kohm resistor between the base and emitter clips of the harness. 3)Connect the (+) lead of a millivoltmeter to the base clip and the (-) lead to the emitter clip.	VR101 (100kohm)	Adjust VR101 so the display reads 700mV.

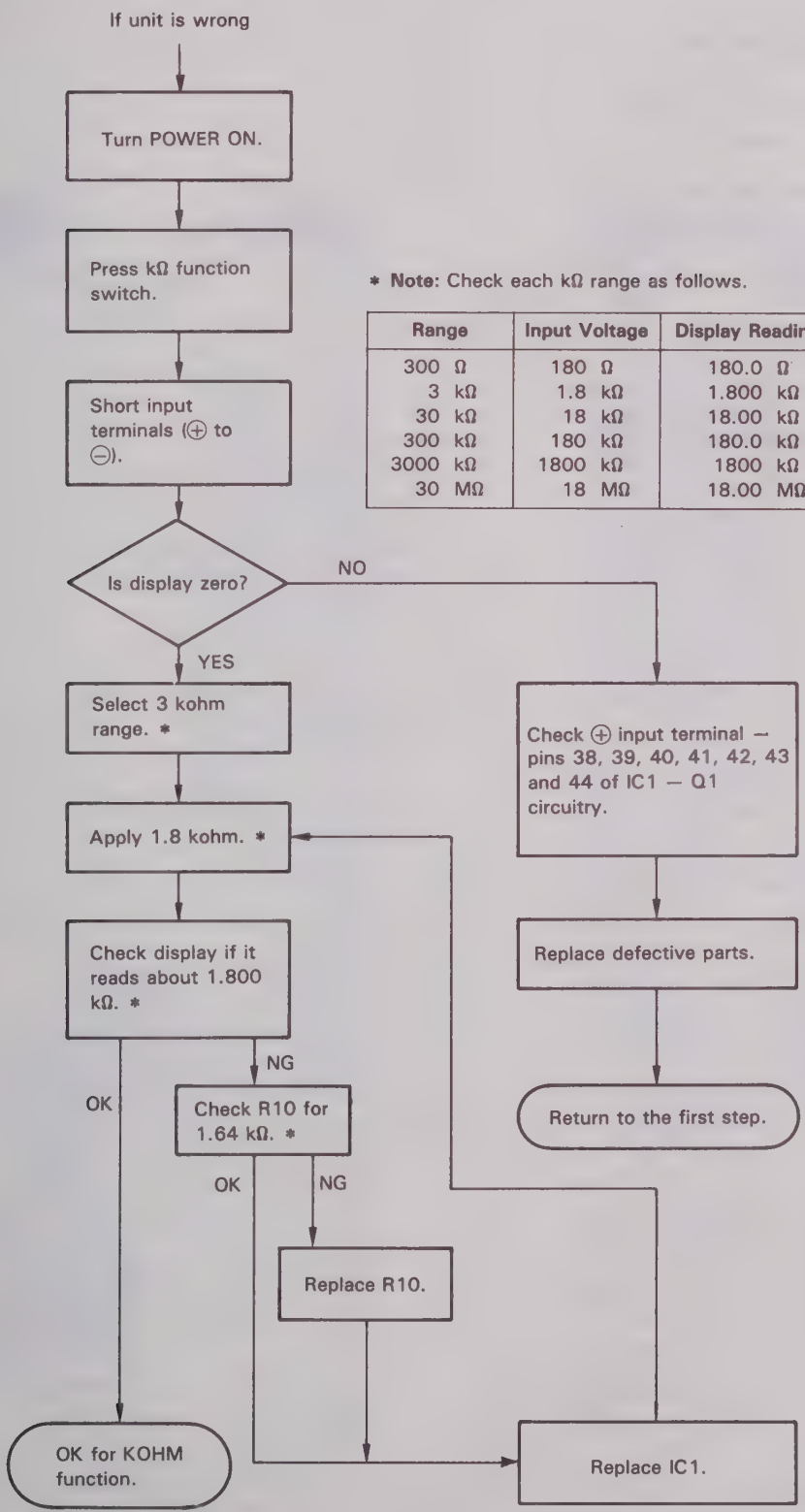
① Troubleshooting of DCV/ACV Measurement Functions


If unit is wrong
Turn POWER ON.
Set function switches to ACV to DCV.
Short input terminals (⊕ to ⊖).
Is display zero?
NO
YES
Select 30V range.
Apply 18V DC or AC.
Check voltage after R1 for 180 mV DC or AC.
NG
OK
Replace R1.
Check voltage between pins 24 and 25 of IC1 for about 162 mV.
NG
OK
OK for DCV/ACV functions.
Check ⊕ input terminal — pin 37 of IC1 — pins 33, 34, 35 and 36 of IC1 — ground circuitry.
Replace IC1 if defective.
Return to the first step.
Recalibrate VR1 for DCV and VR3 for ACV.
If voltage is still wrong, replace IC1.

② Troubleshooting of DCmA/ACmA Measurement Functions


If unit is wrong
Turn POWER ON.
Set function switches to DCmA or ACmA.
Short input terminals (⊕ to ⊖).
Is display zero?
NO
YES
Press 300 mA function switch.
Apply 180 mA DC or AC.
Check voltage after R32 for 180 mV DC or AC.
NG
OK
Replace R32.
Check voltage between pins 24 and 25 of IC1 for about 162 mV.
NG
OK
OK for DCmA/ACmA functions.
Check ⊕ input terminal — pin 31 of IC1 — R32 — ground circuitry.
Replace defective parts.
Return to the first step.
Recalibrate VR1 for DCmA and VR3 for ACmA.
If voltage is still wrong, replace IC1.

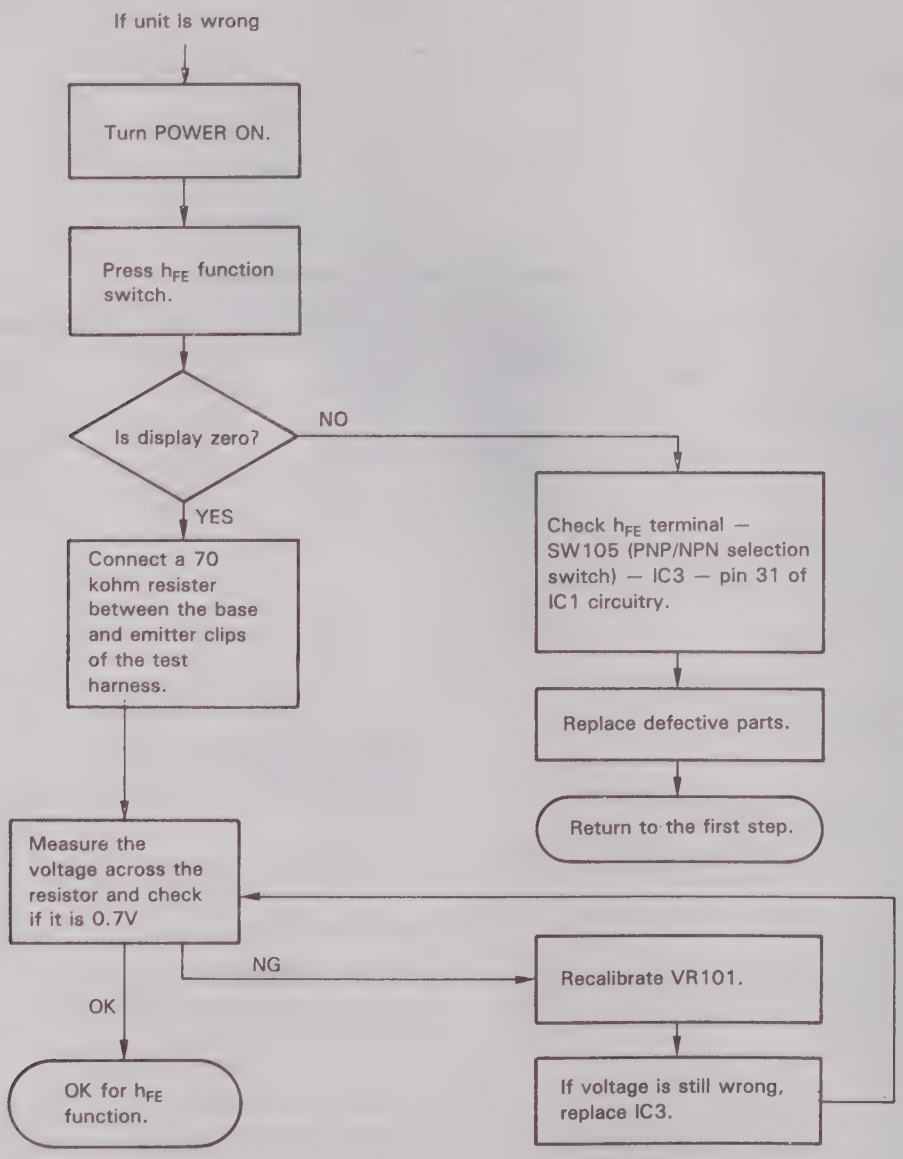
③ Troubleshooting of KOHM Function


If unit is wrong
Turn POWER ON.
Press kΩ function switch.
Short input terminals (⊕ to ⊖).
Is display zero?
NO
YES
Select 3 kohm range. *
Apply 1.8 kohm. *
Check display if it reads about 1.800 kΩ. *
NG
OK
Check R10 for 1.64 kΩ. *
OK
NG
Replace R10.
OK for KOHM function.
Check ⊕ input terminal — pins 38, 39, 40, 41, 42, 43 and 44 of IC1 — Q1 circuitry.
Replace defective parts.
Return to the first step.
Replace IC1.

* **Note:** Check each kΩ range as follows.

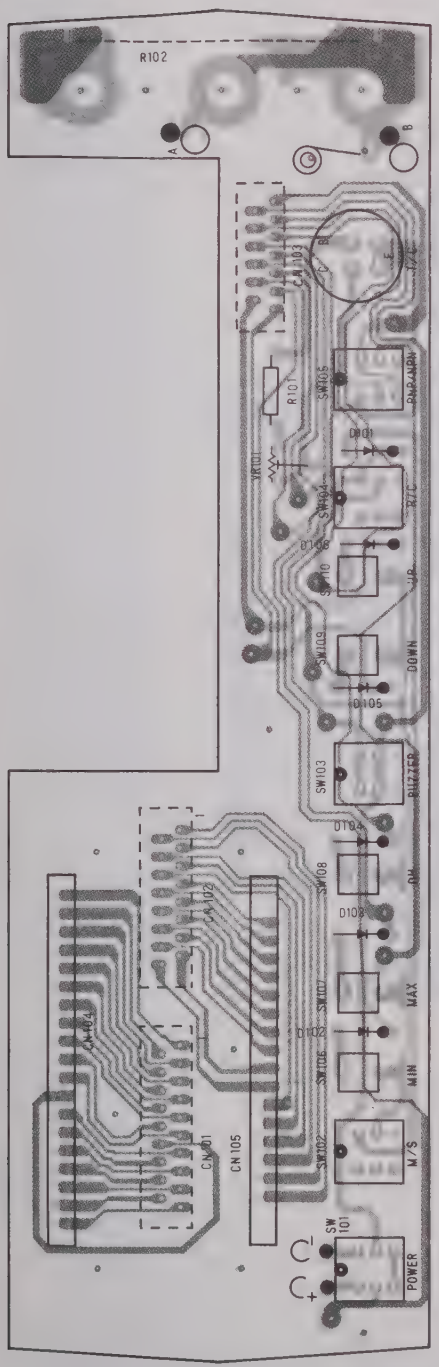
Range	Input Voltage	Display Reading	Resistors to be checked
300 Ω	180 Ω	180.0 Ω	R11 (164 Ω)
3 kΩ	1.8 kΩ	1.800 kΩ	R10 (1.64 kΩ)
30 kΩ	18 kΩ	18.00 kΩ	R9 (16.4 kΩ)
300 kΩ	180 kΩ	180.0 kΩ	R8 (164 kΩ)
3000 kΩ	1800 kΩ	1800 kΩ	R7 (1.64 MΩ)
30 MΩ	18 MΩ	18.00 MΩ	R6 (16.4 MΩ)

④ Troubleshooting of h_{FE} Function

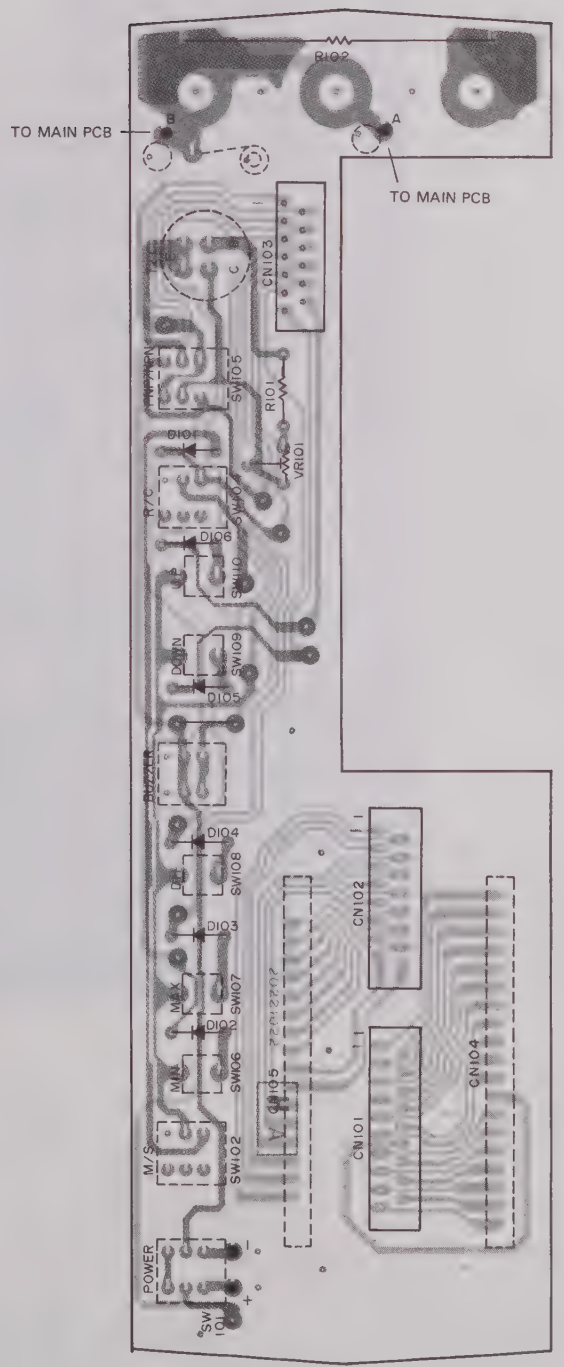

If unit is wrong
Turn POWER ON.
Press h_{FE} function switch.
Is display zero?
NO
YES
Check h_{FE} terminal — SW105 (PNP/NPN selection switch) — IC3 — pin 31 of IC1 circuitry.
Replace defective parts.
Return to the first step.
Connect a 70 kohm resister between the base and emitter clips of the test harness.
Measure the voltage across the resistor and check if it is 0.7V
NG
Recalibrate VR101.
OK
If voltage is still wrong, replace IC3.
OK for h_{FE} function.

SUB PCB

TOP VIEW

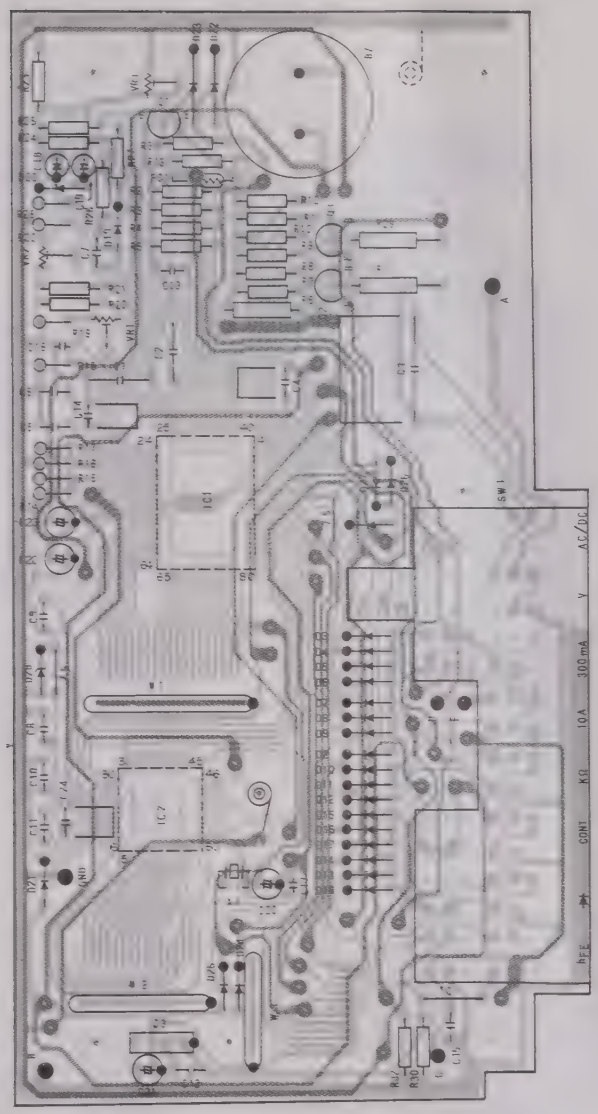


BOTTOM VIEW



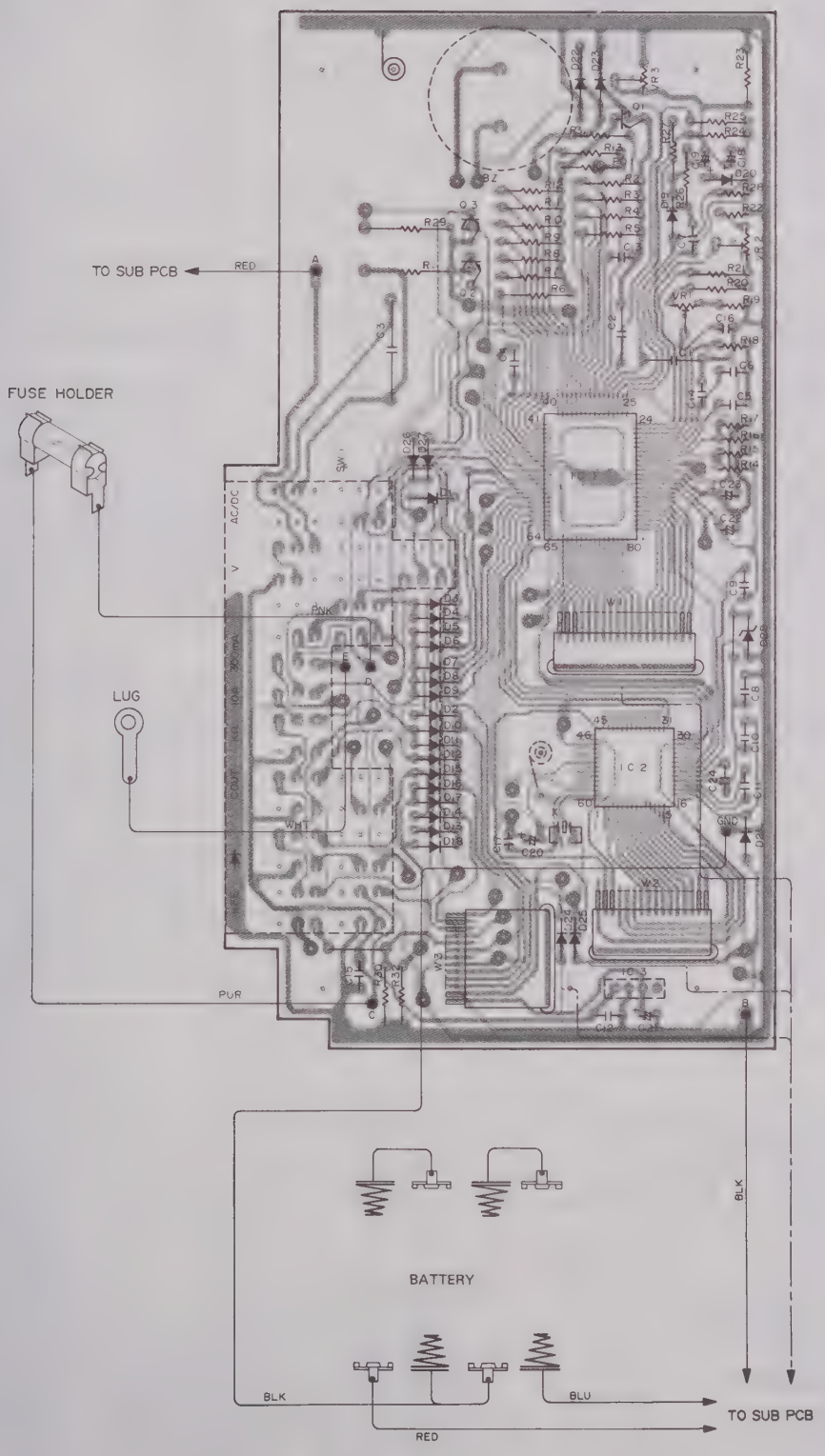
MAIN PCB

TOP VIEW



MAIN PCB

BOTTOM VIEW/WIRING DIAGRAM



Ref. No.	Description	RS Part No.	Mfr's Part No.
BUZZER			
BZ1	EFB-RD24C41	B-7036	272010110A
CAPACITORS			
C1/2	M-Plastic 0.22µF 100V +-10% or	CC-224KLBY	CFRMNA01KV or
	or		CFQMN224KU or
			CFQMN224KR
C3	M-Plastic 0.022µF 1000V +-10%	CC-223KXBY	CFQMZA01KF or
			CFQMZA02KB
C4-7	Mylar* 0.1µF 50V +-10% or	CC-104KJBM	CQQSK104KV or
			CQQBK104KF
C8-11	Mylar 0.047µF 100V +-10%	CC-473KJBM	CQQMN473K*
C12	Mylar 0.1µF 50V +-10% or	CC-104KJBM	CQQSK104KV or
			CQQBK104KF
C13/14	Mylar 0.01µF 100V +-10%	CC-103KJBM	CQQMN103K*
C15	Ceramic 0.01µF 1000V +80-20%	CC-103ZXBC	CKJPY103ZF
C16	Ceramic 390pF 50V +-10%	CC-391KJBC	CKJHK391K*
C17	Ceramic NPO 10pF 50V +-1pF	CF-1145	CCJBK100F*
C18/19	Tantalum 2.2µF 16V +-20% or	CC-225MDCT	CSEEG225M* or
	Tantalum 2.2µF 25V +-20% or		CSEEI225M* or
	Tantalum 2.2µF 35V +-20%		CSEEJ225M*
C20	Electrolytic 22µF 25V +-20%	CC-226MFBA	CEBCI226M*
C21	Electrolytic 10µF 25V +-20%	CC-106MFBA	CEBCI106M*
C22/23	Electrolytic 4.7µF 50V +-20%	CC-475MJBA	CEBCK475M*
C24	Mylar 0.1µF 50V +-10% or	CC-104KJBM	CQQSK104KV or
			CQQBK104KF
CONNECTORS			
CN101	Wire CF-019A Main to LCD		193911030A
CN102	Wire CF-016A Main to LCD		193911020A
CN103	Wire CF-013A Main to SUB		193911010A
CN104/105	For LCD		199910310A or
			199910311A
CRYSTAL			
X1	32768Hz OSC	MX-1039	391011470A or
		MX-1030	391010070A
DIODES			
D1-20	Silicon ITT73N Switching or	DX-1008	SDSI00021- or
	1N4148 or	DX-0022	SDSI00062- or
		DX-0022	SDSI00009-

NOTE: *Mylar is a registered trademark of E. I. Du Pont de Nemours and Company.

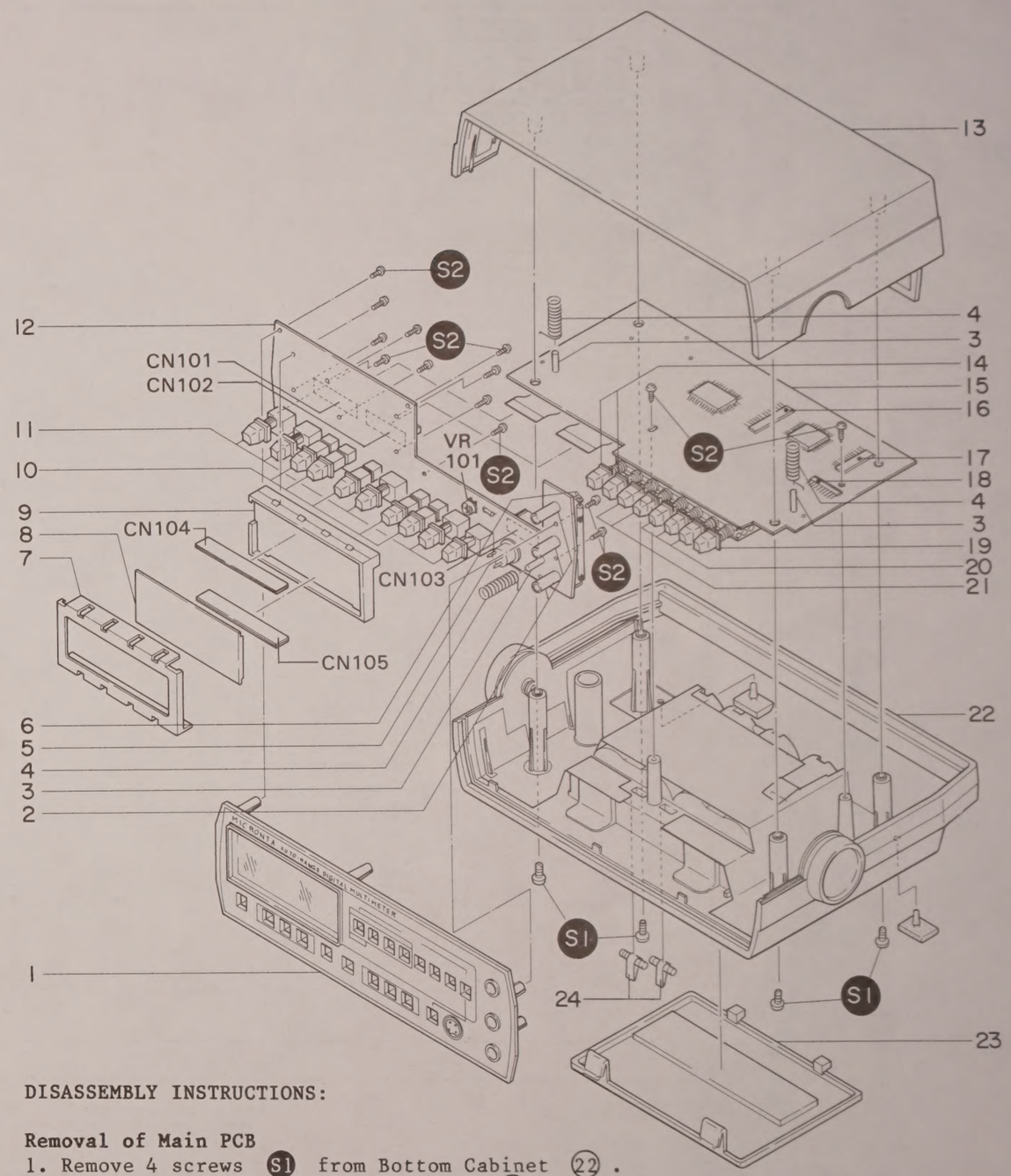
Ref. No.	Description			RS Part No.	Mfr's Part No.
D21	Silicon ITT73N SW/Protector		or	DX-1008	SDSI00021- or
	1N4148		or	DX-0022	SDSI00062- or
				DX-0022	SDSI00009-
D22/23	Silicon 10D2 Protector		or	DX-0587	SDSI00002- or
	SR1K-4			DX-0476	SDSI00027-
D24-26	Silicon ITT73N SW/Protector		or	DX-1008	SDSI00021- or
	1N4148		or	DX-0022	SDSI00062- or
				DX-0022	SDSI00009-
D27	Silicon ITT73N Protector		or	DX-1008	SDSI00021- or
	1N4148		or	DX-0022	SDSI00062- or
				DX-0022	SDSI00009-
D28	Zener RD5.1E-B Protector			DX-0398	SZRD5.1EB-
				DX-0022	SDSI00009-
D101-106	Silicon ITT73N Switching		or	DX-1008	SDSI00021- or
	1N4148		or	DX-0022	SDSI00062- or
				DX-0022	SDSI00009-
ICs					
IC1	SMC4301F0A C-MOS A/D Convertor			MX-7142	SIS14301FA
IC2	SMC6115F0A C-MOS Driver			MX-7143	SIS16115FA
IC3	LA5002 Linear Regulator			MX-7144	SILA5002--
POSISTOR					
PO1	911x04E102YU13			RX-0208	SDPS00005-
POTENTIOMETERS					
VR1	Semi-Fixed 10kB DC-V/A Adj			P-6013	177110990A
VR2	Semi-Fixed 2kB DC-V/A Adj			P-6141	177110970A
VR3	Semi-Fixed 500kB AC-V/A Adj			P-6014	177111040A
VR101	Semi-Fixed 100kB h_{FE} Adj			P-6147	177111020A
RESISTORS					
R1	M-Film	10Mohm	1/2W+-0.5%	N-0482EFE	RM0HP106D*
R2	M-Film	1.11Mohm	1/4W+-0.5%	N-0579EEE	RM0QPA02D*
R3	M-Film	101kohm	1/4W+-0.5%	N-0580EEE	RM0QPA01D*
R4	M-Film	10kohm	1/4W+-0.5%	N-0281EEE	RM0QP103D*
R5	M-Film	1kohm	1/4W +-5%	N-0196EEE	RM0QP102D*
R6	M-Film	16.4Mohm	1/2W +-1%		RM0HPA01F*
R7	M-Film	1.64Mohm	1/4W +-1%		RM0QPA17F*
R8	M-Film	164kohm	1/4W +-1%		RM0QPA18F*
R9	M-Film	16.4kohm	1/4W +-1%		RM0QPA19F*
R10	M-Film	1.64kohm	1/4W +-1%		RM0QPA20F*
R11	M-Film	164 ohm	1/4W +-1%		RM0QPA21F*
R12/13	Carbon	330kohm	1/4W +-5%	N-0410EEC	RCSQM334J*
R14	M-Film	750kohm	1/4W +-1%	N-0439BEE	RM0QU754F*

Ref. No.	Description	RS Part No.	Mfr's Part No.
R15	M-Film 118kohm 1/4W +-1% (For CAL.)	N-0374BEE	RM0QUA20F*
	M-Film 123kohm 1/4W +-1% (For CAL.)		RM0QUA25F*
R16	M-Film 107kohm 1/4W +-1% (For CAL.)	N-0372BEE	RM0QUA19F*
	M-Film 100kohm 1/4W +-1% (For CAL.)		RM0QU104F*
R17	M-Film 750kohm 1/4W +-1%	N-0439BEE	RM0QU754F*
R18	M-Film 220kohm 1/4W +-1%	N-0396BEE	RM0QU224F*
R19	M-Film 30kohm 1/4W +-1%	N-0321BEE	RM0QU303F*
R20	M-Film 550kohm 1/4W +-1%	N-0841BEE	RM0QP553F*
R21	M-Film 34kohm 1/4W +-1%	N-0325BEE	RM0QP343F*
R22	M-Film 4.6kohm 1/4W +-1%	N-0840BEE	RM0QU462F*
R23	M-Film 27kohm 1/4W +-1%	N-0316BEE	RM0QP273F*
R24	M-Film 22kohm 1/4W +-1%	N-0311BEE	RM0QP223F*
R25	M-Film 330kohm 1/4W +-1%	N-0410BEE	RM0QP334F*
R26	M-Film 22kohm 1/4W +-1%	N-0311BEE	RM0QP223F*
R27	M-Film 330kohm 1/4W +-1%	N-0410BEE	RM0QP334F*
R28	M-Film 22Mohm 1/2W +-1%	N-0585BFE	RM0HP226F*
R29	M-Film 10Mohm 1/2W +-1%	N-0482BFE	RM0HP106F*
R30	M-Film 10 ohm 1/4W +-1%	N-0063BEE	RM0QP100F*
R31	M-Film 10kohm 1/4W +-1%	N-0251BEE	RM0QP103F*
R32	M-Film 0.92ohm 1/4W +-1% (For CAL.)		RM0QPR92F*
	M-Film 0.91ohm 1/4W +-1% (For CAL.)		RM0QPR91F*
R101	Carbon 51kohm 1/4W +-5%	N-0344EEC	RCSQM513J*
R102	Wire Resist D1.6 MANGANIN	W-3203	W5A1R6MT-Y
	SWITCHES		
SW1	Push Function	S-7051	182810020A
SW101-105	Push Power/Memo/Buzzer/R-C/PNP-NPN	S-7052	182110740A
SW106-110	Key MIN/MAX/DH/DOWN/UP	S-7579	187010030A
	TRANSISTORS		
Q1	2SD400(E) NPN Protector or 2SD400(F)	2SD-400F	ST2D400--E or ST2D400--F
Q2/3	2SC536(F) NPN Protector or 2SC536(G) or 2SC536(H)	2SC-536	ST2C536--F or ST2C536--G or ST2C536--H
	MISCELLANEOUS		
	Eyelet, 1.3x2.5 Contact for Solder		HAE21325BA
	Lead, Test Banana Type	W-3417	315010012B
	Cord Ass'y, Terminal with Contact	W-3418	316011330A

EXPLODED VIEW PARTS LIST

Ref. No.	Description	RS Part No.	Mfr's Part No.
1	Front Cabinet Ass'y	Z-0867	M-00627
	Cabinet, Front		601010400A
	Window	G-0089	713510470A
	Plate, Range		711610110A
	Sheet, Shield		473310940A
2	Terminal, Tester C3601BD Ni-3		194510120A
3	Shaft, for Main PCB/Sub PCB	RT-2483	416210320A
4	Spring, Coil for Main PCB/Sub PCB	RB-5568	434110520A
5	Contact, Test hFE		194610060A
6	Lug, BS-2-B1 for R/Wire		HALB20103N
7	Holder, for LCD	HC-4054	413101260A
8	LCD, LD-BU7159	L-1994	553510080A
9	Holder, for LCD	HC-4053	413101250A
10	Knob, M-Min,Max/DH/RC-Down,Up	K-0702	659511320A
11	Knob, Power/M-Start,Reset/Buzzer/ RC-Manual, Auto/PNP,NPN/hFE	K-0701	655010460A
12	Sub PCB Unit	XB-1256	U-25553
13	Top Cabinet Ass'y	Z-0868	M-00628
	Cabinet, Top		601211480A
	Foot		608010410A
	Sheet, Shield		473310920A
14	Knob, AC/DC-V	K-0967	655010451A
15	Main PCB Unit	XB-1255	U-25552
16	Wire, Flat Main to LCD (Figures)	W-0031	317010870A
17	Wire, Flat Main to LCD	W-0030	317010860A
18	Wire Flat Main to Sub	W-0024	317010850A
19	Knob, hFE	K-0696	655010450A
20	Knob, kohm/CONT/Diode Check	K-0699	655010453A
21	Knob, 300mA/10A	K-0698	655010452A
22	Bottom Cabinet Ass'y	Z-0869	M-00629
	Cabinet, Bottom		601311280A
	Sheet, Shield		473310930A
	Handle	H-6027	714010100A
	Spring, Coil for Handle	RB-5566	434110530A
	Washer, 6W ZnY for Handle	HD-8007	HAWP60SSSY
	E-ring, 4E ZnW for Handle	HE-0010	HAGE40S-SW
	Washer, BS-6.2x13x0.1		HAWP601CBN
	Contact, Battery +	B-0228	198110680A
	Contact, Battery Ass'y With Spring +-	B-0230	198110720A
	Contact, Battery Ass'y With Spring -	B-0232	198110700A
	Contact, Battery Ass'y With Contact -+	B-0233	198110740A
	Ribbon, Nylon for Battery		851410130A
	Foot, Silicon Rubber	F-0059	608010360A
	Holder, Fuse		197100151A
	Screw, Taptite 3x8BT-B for Holder		HCBB3008SY
23	Cover, Battery With Cushion	DB-0099	602110510A
24	Fuse 250V 0.5A	HF-0085	251210080A
	Hardware Kit	HW-2200195	HWK220195
S1	Screw, Taptite 3x12BT-B ZnY		HCBB3012SY

EXPLODED VIEW/DISASSEMBLY



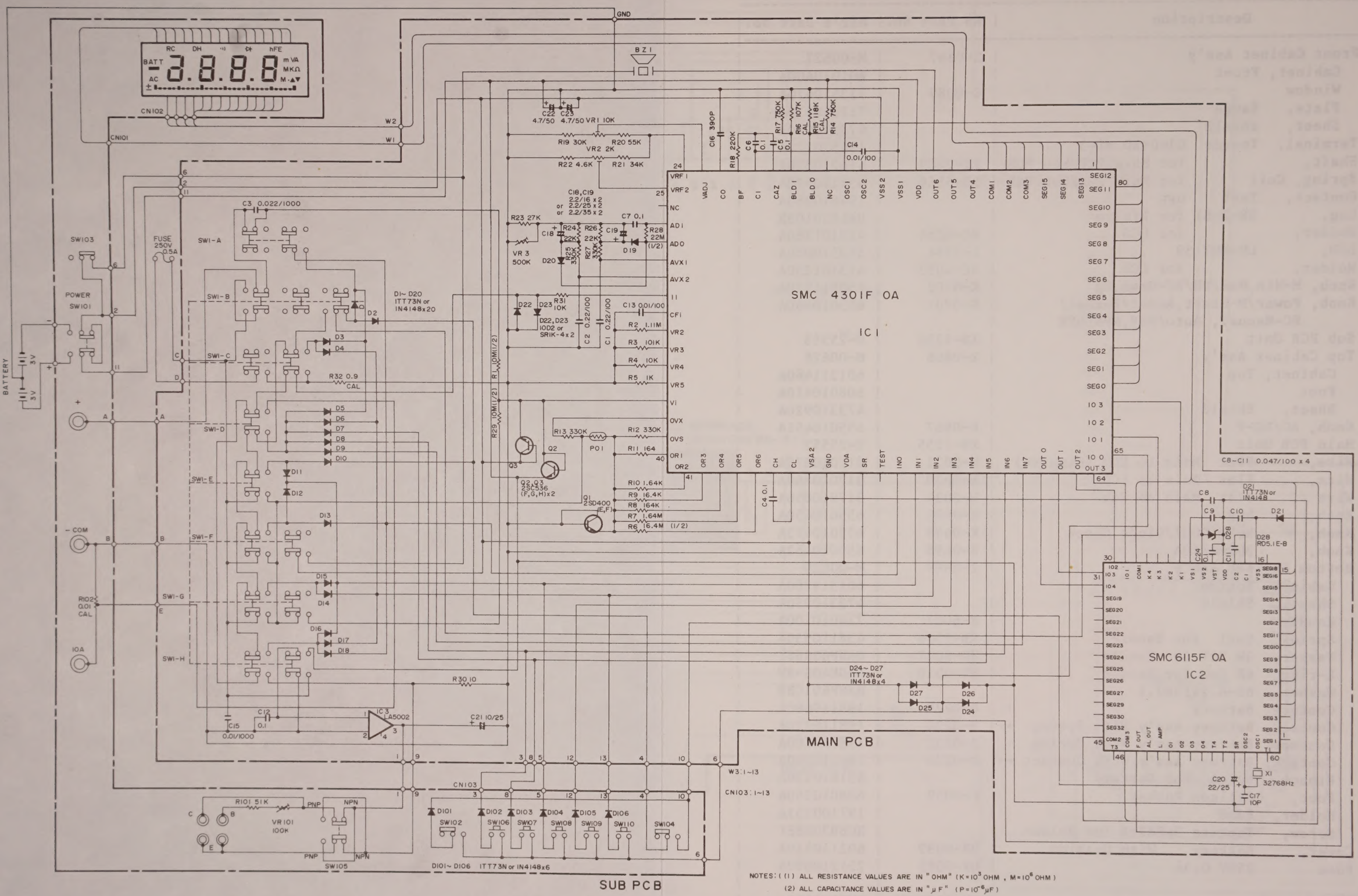
DISASSEMBLY INSTRUCTIONS:

Removal of Main PCB
1. Remove 4 screws (S1) from Bottom Cabinet (22).
2. Remove 2 screws (S2) from Main PCB (15).

Removal of Sub PCB
Remove 6 screws (S2) from Sub PCB (12).

Removal of LCD
Remove other 6 screws (S2) on the Sub PCB.

SCHEMATIC DIAGRAM



NOTES: (1) ALL RESISTANCE VALUES ARE IN "OHM" (K=10^3 OHM, M=10^6 OHM)
(2) ALL CAPACITANCE VALUES ARE IN "μF" (P=10^{-6}μF)
(3) SWITCHES:

SWI FUNCTION SELECT (DC V POSITION)

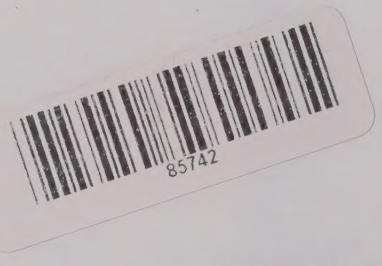
SWI-A DC/AC SELECT	SWI-G DIODE CHECK	SW105 PNP/NPN SELECT
SWI-B V	SWI-H h_{FE} CHECK	SW106 MEMORY VALUE MIN.
SWI-C 300mA	SW101 POWER	SW107 MEMORY VALUE MAX.
SWI-D 10A	SW102 MEMORY START/RESET	SW108 DATA HOLD
SWI-E KΩ	SW103 BUZZER	SW109 RANGE CONTROL DOWN
SWI-F CONTINUITY	SW104 RANGE CONTROL MANUAL/AUTO	SW110 RANGE CONTROL UP

TRANSISTOR LEAD IDENTIFICATION

2SC536

2SD400

*For IC description, see pages 6 and 7.



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